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Explanatory factor analysis on islamic education teachers' level of technological pedagogical content knowledge (TPACK) at primary schools

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ABSTRACT

This study aims to measure teachers' Technological Pedagogical Content Knowledge (TPACK) level and analyze the factors that influence their TPACK level. It was conducted at Islamic primary schools in Gresik Regency, East Java, Indonesia. Involving 246 teachers as a sample, this study employed a mixed-method approach, combining quantitative and qualitative analysis. Quantitative data were analyzed using descriptive analysis and Structural Equation Modeling (SEM) to identify the relationships between variables affecting TPACK. Meanwhile, qualitative data were obtained through in-depth interviews with several teachers to understand their context and experiences in applying TPACK. The results showed that factors such as technology training, institutional support, professional teaching certification, and personal motivation significantly influenced the TPACK level of teachers. These findings provide important insights for the development of more effective training programs and enhanced institutional support to improve teachers' TPACK, aiming to facilitate more interactive and meaningful learning.

Introduction

The integration of technology into education has transformed teaching methodologies, compelling educators to adapt their practices to align with the demands of 21st-century learning. Teachers' ability to integrate technology effectively is encapsulated in the framework of Technological Pedagogical Content Knowledge (TPACK), which combines content knowledge, pedagogical expertise, and technological proficiency (Mishra & Koehler, 2006). While the TPACK framework has gained significant traction globally, its application and relevance in the context of Islamic education remain underexplored. Understanding Islamic education teachers' TPACK levels is essential for fostering a dynamic and inclusive learning environment that harmonizes traditional values with technological advancements.

Islamic education, which emphasizes moral and spiritual development alongside academic achievement, poses unique challenges for technology integration. Studies suggest that primary school teachers in Islamic settings often struggle to adopt technology due to limited resources, lack of training, or resistance to change (Majed, 2018; Lubis et al., 2018).However, integrating technology effectively could enrich learning experiences and make traditional subjects more

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accessible and engaging for students (Chander & Arora, 2021). This study seeks to address the gap by investigating Islamic education teachers' TPACK levels, providing critical insights into their readiness and the barriers they face.

Explanatory Factor Analysis (EFA) has emerged as a robust statistical tool for identifying underlying factors that contribute to complex constructs like TPACK. By applying EFA, this study can uncover dimensions specific to Islamic education teachers, offering a nuanced understanding of their technological, pedagogical, and content knowledge integration. Previous research has demonstrated the efficacy of EFA in exploring teacher competencies in diverse educational contexts, but limited attention has been paid to its application in Islamic education settings (U. Hasanah & Nafi'ah, 2021).

The focus on primary schools is particularly significant, as they play a foundational role in shaping students' cognitive and moral development. Effective technology integration at this level not only enhances academic outcomes but also cultivates critical thinking and ethical awareness (D.E.M. Gómez, 2024). However, Islamic education teachers at primary schools often experience unique constraints, such as balancing religious teachings with modern pedagogical approaches (Assalihee et al., 2024). This highlights the need for targeted research to understand and support their professional development.

This study is critical for policy-making and curriculum development in Islamic educational institutions. By identifying key factors influencing teachers' TPACK levels, stakeholders can design tailored training programs and allocate resources more effectively. Furthermore, this research contributes to the global discourse on educational equity, ensuring that Islamic education is not left behind in the technological revolution (Syahputra et al., 2022). Ultimately, this study extends the literature on TPACK by contextualizing it within Islamic education at primary schools, a domain that remains underrepresented in academic discourse. By employing explanatory factor analysis, the research aims to uncover nuanced insights into the multifaceted nature of TPACK, contributing to the ongoing efforts to align technology integration with the unique needs of Islamic education.

The Technological Pedagogical Content Knowledge (TPACK) framework has emerged as a vital paradigm for understanding how teachers integrate technology into their pedagogical practices. TPACK, developed by Mishra & Koehler (2006), emphasizes the interplay between three core domains: technological knowledge, pedagogical knowledge, and content knowledge. In the context of Islamic education, this framework provides a robust lens for examining how educators utilize technology to enhance their teaching while preserving the spiritual and moral dimensions of Islamic teachings. The incorporation of technology in Islamic education is not merely about the usage of tools but involves aligning technological applications with pedagogical strategies and Islamic content to foster an engaging and holistic learning experience (Azaliah Mar et al., 2024). Scholars argue that effective integration of technology in Islamic education demands a balance between modern instructional methods and the core tenets of Islam, ensuring that technological tools support, rather than dilute, the educational objectives (Sholeh, 2023)

Research in this area highlights several challenges and opportunities for Islamic education teachers striving to develop TPACK competencies. For instance, teachers often lack access to resources, training, and institutional support necessary to integrate technology effectively(Johnson et al., 2016). Despite these challenges, studies indicate that technology can significantly enhance students' engagement with Islamic content through interactive platforms, digital storytelling, and gamified learning activities (N. Hasanah, 2024). Moreover, professional development initiatives focusing on TPACK have shown promising results in equipping Islamic education teachers with the skills to create innovative and contextually relevant teaching practices (Yusoff et al., 2022).

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However, the literature underscores the need for more empirical studies to investigate the unique intersection of TPACK in Islamic education, particularly at the primary school level, to build a comprehensive understanding of how teachers navigate this complex integration (Osman (2020)

The development of teachers' Technological Pedagogical Content Knowledge (TPACK) is influenced by a range of factors, including individual, institutional, and contextual elements. Personal factors such as teachers' attitudes toward technology, their self-efficacy in using digital tools, and their prior experiences with technology play a significant role in shaping their TPACK levels (Ertmer & Ottenbreit-Leftwich, 2010). Teachers who view technology as a beneficial tool for enhancing teaching are more likely to explore and integrate innovative approaches in their classrooms (Koehler et al., 2013). Additionally, teachers' professional development experiences significantly contribute to their TPACK growth. Targeted training programs focusing on the intersection of technology, pedagogy, and content knowledge have been shown to improve educators' ability to use technology effectively, especially when such programs are context-specific and continuous(Bungai et al., 2024; Adji et al., 2022).

Institutional and contextual factors also play a critical role in determining teachers' TPACK levels. Access to resources such as infrastructure, digital tools, and technical support is essential for fostering technology integration in teaching (Tondeur et al., 2017). Moreover, the presence of a supportive school culture and leadership that encourages innovation and collaboration enhances teachers' motivation to develop their TPACK competencies (Cai & Tang, 2022; Özgür, 2020). Contextual challenges, such as socio-economic disparities, cultural attitudes toward technology, and curriculum constraints, can either facilitate or hinder the development of TPACK (McDougall & Phillips, 2024). Studies emphasize that the interplay between these factors often determines how effectively teachers can adopt and integrate technology into their pedagogical practices (C. S. Chai et al., 2020; Polly et al., 2010). Understanding these influential factors is essential for designing interventions that address gaps in TPACK development and promote equitable access to technology-enhanced education.

Method

This study employed a mixed-methods approach, combining quantitative and qualitative data collection techniques to comprehensively assess the level of Technological Pedagogical Content Knowledge (TPACK) among Islamic education teachers and explore the influential factors affecting their TPACK development. A total of 426 Islamic education teachers from both private and public primary schools in Gresik, East Java, Indonesia, participated in the study. The quantitative component involved the use of Structural Equation Modeling (SEM) to measure the TPACK levels of these teachers. A validated TPACK questionnaire adapted from (Tseng, 2016) was administered, consisting of 35 items designed to assess teachers' technological knowledge, pedagogical knowledge, content knowledge, and their intersections. The SEM approach was chosen to provide a robust analysis of the relationships between various TPACK constructs and to identify key predictors of teachers' TPACK proficiency.

The qualitative component involved in-depth interviews with a purposive sample of 10 teachers from both higher and lower level of TPACK. These interviews aimed to explore the underlying factors influencing teachers' TPACK development, including personal attitudes, institutional support, and contextual challenges. The interview questions were semi-structured, allowing for a detailed exploration of participants' experiences and perceptions while maintaining a consistent focus on the research objectives. The qualitative data were analyzed thematically to identify recurring patterns and insights that complemented the quantitative findings. This mixed-

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methods design ensured a holistic understanding of TPACK levels and the factors shaping them, providing actionable insights for educators, policymakers, and professional development providers.

Result

The results of this study are presented in two main sections: the quantitative findings, which assess the Technological Pedagogical Content Knowledge (TPACK) levels of Islamic education teachers using descriptive statistic and Structural Equation Modeling (SEM), and the qualitative findings, which explore the influential factors affecting these levels based on in-depth interviews. To see the profile of the teachers, it can be seen from Table 1.

Table 1: Demographic Profiles of Respondents

No	Description	Number (n=246)	Percentages (%)
Teachers distribution based on:			
a) Subject Matters			
1	Al Qur'an Hadith	41	16,67
2	Fiqh	49	19,92
3	Islamic History	36	14,63
4	Aqidah and Akhlaq	44	17,89
5	Arabic	48	19,51
6	Religious Local Content	28	11,38
b) Gender			
1	Male	108	56,10
2	Female	138	43,90
c) Age			
1	<20	0	-
2	21-30	72	29,27
3	31-40	62	25,20
4	41-50	68	27,64
5	>51	44	17,89
d) Teaching experiences			
1	1-5	85	34,55
2	6-10	37	15,04
3	11-15	17	6,91
4	16-20	52	21,14
5	Lebih dari 20	55	22,36
e) Professional Certification			
1	Yes	134	54,47
2	No	112	45,53

The distribution of teachers across subject matters reveals a relatively balanced allocation, with the highest percentages found in Fiqh (19.92%) and Arabic (19.51%), followed by Aqidah and Akhlaq (17.89%) and Al-Qur'an Hadith (16.67%). Islamic History (14.63%) and Religious Local Content (11.38%) have slightly lower representation. This suggests a prioritization of core Islamic education subjects, with a need to address the lesser focus on local religious content. Gender-wise, male teachers slightly outnumber female teachers, constituting 56.10% of the total, compared to 43.90% females. This imbalance may indicate gender-related trends in teacher recruitment or preference for specific subject areas, warranting further exploration to promote gender equity.

From Table 1, it also can be revealed that age distribution indicates a relatively youthful teaching workforce, complemented by experienced senior teachers, contributing to a blend of new perspectives and seasoned expertise. Regarding teaching experience, most teachers have 1-5 years

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of experience (34.55%), followed by those with over 20 years (22.36%) and 16-20 years (21.14%). Teachers with 6-10 years (15.04%) and 11-15 years (6.91%) experience constitute smaller groups, indicating a significant influx of new educators in recent years alongside a stable cohort of veteran teachers. Finally, professional certification data shows that 54.47% of teachers possess certification, while 45.53% do not. Although the majority are certified, nearly half of the teachers lack this qualification, highlighting an area for improvement to enhance professional standards in the workforce.

Table 2: Teachers' TPACK level

No	Domain	Mean	x̄ SD
1	Technonological Knowledge	3.95	0.959
2	Pedagogical Knowledge	4.03	0.984
3	Content Knowledge	4.19	0.966
4	Technological Pedagogical Knowledge	3.90	0.813
5	Technological Content Knowledge	3.81	0.856
6	Pedagogical Content Knowledge	3.82	0.904
7	Technological Pedagogical Content Knowledge	3.73	0.878

Refer to Table 2, it reveals insights into the teachers' levels of Technological Pedagogical Content Knowledge (TPACK) across its domains. Among the seven domains assessed, Content Knowledge (CK) scores the highest mean of 4.19 (SD = 0.966), indicating that teachers feel most confident in their mastery of the subject matter they teach. This is followed by Pedagogical Knowledge (PK) with a mean of 4.03 (SD = 0.984), reflecting strong competence in instructional strategies and classroom management. In contrast, domains integrating technology—such as Technological Pedagogical Knowledge (TPK, mean = 3.90, SD = 0.813), Technological Content Knowledge (TCK, mean = 3.81, SD = 0.856), and Technological Pedagogical Content Knowledge (TPACK, mean = 3.73, SD = 0.878)—exhibit lower scores. Technological Knowledge (TK) itself scores 3.95 (SD = 0.959), showing moderate confidence in using technological tools independently. The lowest scoring domain, TPACK, highlights the challenge of integrating technology seamlessly into pedagogical and content-specific contexts.

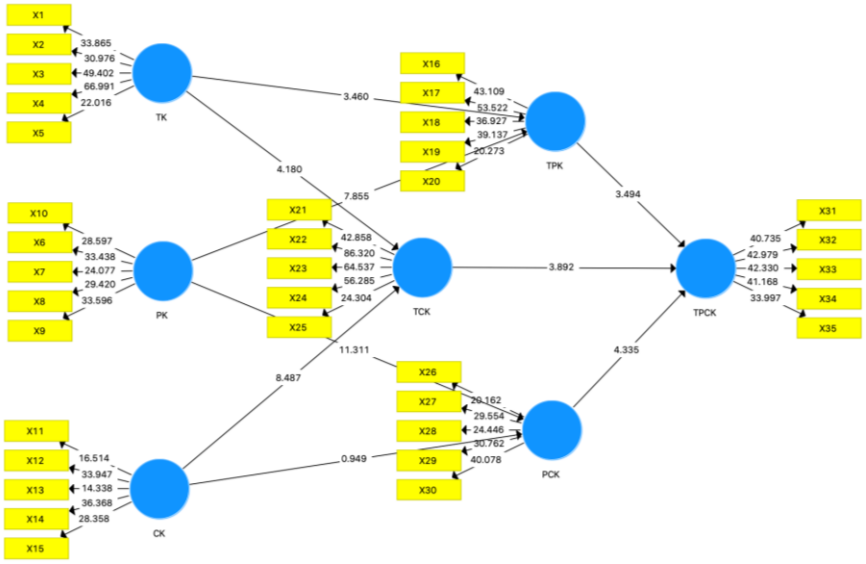

Figure 1: Bootstrapping Technique

It can be obviously seen from Table 3 that the data provide insights into the relationships and impacts of various TPACK components. Each path reflects the strength and significance of the relationships between the constructs, with particular emphasis on Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), and their intersections as also depicted in Figure 1. The relationship between Content Knowledge (CK) and Pedagogical Content Knowledge (PCK) is weak and statistically insignificant (Path Coefficient: 0.068, p = 0.343; p > 0.05). This suggests that CK alone does not strongly influence PCK development, highlighting the necessity of pedagogical expertise to effectively translate content into teachable forms. A strong and statistically significant relationship exists between CK and TCK (Path Coefficient: 0.513, p = 0.000), indicating that teachers with higher CK are better able to integrate content with technological tools. It emphasizes the importance of content mastery as a foundation for leveraging technology effectively.

Table 3: Final Results of Path Coefficients

	Original Sample (O)	Sample Mean (M)	SD	T Statistics	P Value
CK →PCK	0.068	0.075	0.072	0.949	0.343
CK →TCK	0.513	0.513	0.060	8.487	0.000
PCK →TPCK	0.297	0.297	0.069	4.335	0.000
PK →PCK	0.739	0.733	0.065	11.311	0.000
PK →TPK	0.531	0.525	0.068	7.855	0.000
TCK →TPCK	0.351	0.351	0.090	3.892	0.000
TK →TCK	0.252	0.253	0.060	4.180	0.000
TK →TPK	0.251	0.259	0.073	3.460	0.000
TPK →TPCK	0.281	0.282	0.081	3.494	0.000

The impact of PCK on Technological Pedagogical Content Knowledge (TPACK) is moderate and statistically significant (Path Coefficient: 0.297, p = 0.000). This demonstrates that the ability to blend content and pedagogy forms a critical basis for successfully incorporating technology into teaching. Pedagogical Knowledge (PK) has a very strong and statistically significant influence on PCK (Path Coefficient: 0.739, p = 0.000). This underscores the pivotal role of pedagogical expertise in shaping a teacher's ability to combine pedagogy with content knowledge effectively. PK also significantly impacts Technological Pedagogical Knowledge (Path Coefficient: 0.531, p = 0.000), indicating that robust pedagogical skills enhance a teacher's capability to integrate technology into their teaching strategies.

A significant relationship between TCK and TPACK highlights the importance of combining technology with content as a step toward achieving overall TPACK proficiency (Path Coefficient: 0.351, p = 0.000). The significant relationship between Technological Knowledge (TK) and TCK shows that foundational technological skills are essential for teachers to integrate technology with content knowledge effectively (Path Coefficient: 0.252, p = 0.000). Similarly, the impact of TK on TPK indicates that technological expertise supports teachers in aligning technology with pedagogical practices (Path Coefficient: 0.251, p = 0.000). The relationship between TPK and TPACK is significant, demonstrating that the ability to integrate technology into pedagogy is a crucial component of achieving overall TPACK competency (Path Coefficient: 0.281, p = 0.000).

The teachers' TPACK level can vary due to some factors. Based on the data generated from in-depth interview session with ten teachers, the influential factors tend to be teachers' age,

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institutional support, participation in technology integration workshop, and personal attitude. Table 4 shows some factors that affect teachers' TPACK level.

Table 4: Influential Factors on Teachers' TPACK Level

No	Factors	Teachers' Statement	
		Higher TPACK Level	Lower TPACK Level
1	Teaching Experiences	"Experience gives me confidence in teaching, but I also realized I need to adapt to modern methods. My motivation comes from wanting to stay relevant and improve learning outcomes."	"I rely on traditional methods because they've worked for years. Learning new tools feels unnecessary and time-consuming."
2	Personal Motivation	"I enjoy learning new tools and feel that technology engages students more effectively. I actively look for workshops and online tutorials to enhance my skills." "I see technology as essential. Students expect it, and I enjoy the challenge of finding creative ways to teach using digital tools."	"I find it challenging. I didn't grow up with it, and it feels overwhelming to learn now." "Honestly, I'm not very motivated because I don't feel confident or supported." "I'm skeptical. I prefer face-to-face interaction and feel that technology can be a distraction."
3	Professional Certification	The certification courses encouraged me to explore various digital tools and understand how to use them effectively."	"Not really. The focus wasn't on technology when I got certified."
4	Participation on Technology Workshop, Seminar, etc.	"Attending technology workshops has been a game-changer for me. I learned how to create interactive quizzes and use apps for collaborative projects." "Absolutely. Webinars and online courses keep me updated and inspired."	"I have, but they were too general and didn't address the specific challenges I face in my classroom." "They're helpful in theory, but without tools in the classroom, it's difficult to apply what I've learned."
5	School Support	"Our school provides high-speed internet, projectors, and even organizes training sessions for teachers. This makes integrating technology easier and more enjoyable." "Our principal is very proactive. We have a budget for tech tools, and teachers are encouraged to try new methods."	"Lack of access. We don't have enough devices or reliable internet, so it's hard to practice and improve." "Not really. We don't have enough tools or reliable internet, so I don't see the point in trying." "There's no pressure from the school to use technology, so I stick to what I know works."

The data show clear distinctions between teachers with higher and lower TPACK levels. Teachers with higher TPACK are motivated, supported institutionally, and proactive in professional

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development. However, those with lower TPACK levels cite barriers such as lack of access, institutional support, and personal confidence, reflecting the need for targeted interventions to enhance their skills and attitudes.

Discussion

The aforementioned data offer insights into the Technological Pedagogical Content Knowledge (TPACK) levels of Islamic education teachers. The findings reveal variations across the seven TPACK domains, with Content Knowledge (CK) scoring the highest mean (4.19), while Technological Pedagogical Content Knowledge (TPACK) records the lowest mean (3.73). These results indicate strengths in subject matter expertise but highlight areas requiring improvement, particularly in the integration of technology with pedagogy and content knowledge. Content Knowledge (CK) emerged as the strongest domain with a mean score of 4.19 (SD = 0.966). This result is consistent with the expectation that teachers possess strong expertise in their subject areas, particularly in Islamic education, which often emphasizes mastery of religious texts and concepts. Shulman (1987)argues that CK is the foundation of effective teaching, as it enables teachers to present accurate and nuanced information to students. The high CK score reflects teachers' commitment to maintaining a deep understanding of their field, which is critical for designing effective pedagogical approaches.

Technological Pedagogical Content Knowledge (TPACK), which represents the integrated knowledge necessary for teaching with technology, recorded the lowest mean score (3.73, SD = 0.878). This finding aligns with studies by (Koehler & Mishra, 2009), who assert that TPACK is often the most challenging domain for teachers to master due to the complexity of balancing technological, pedagogical, and content dimensions. Teachers may struggle to effectively integrate technology into their teaching practices, particularly in contexts where professional development opportunities or technological resources are limited (Chai et al., 2013)

Furthermore, the findings of this study also highlight the multifaceted nature of factors influencing teachers' Technological Pedagogical Content Knowledge (TPACK) levels in Islamic education, aligning with and extending existing theoretical frameworks. Age, institutional support, participation in technology workshops, and teachers' personal attitudes emerge as critical determinants. These results echo (Koehler et al., 2013; Mishra & Koehler, 2006) TPACK framework, which emphasizes the dynamic interplay of technological, pedagogical, and content knowledge as essential for effective teaching in technology-integrated environments. Age significantly influences teachers' TPACK levels, with younger teachers generally exhibiting greater ease in adopting technology due to their familiarity and frequent exposure (Ertmer & Ottenbreit-Leftwich, 2010). Older teachers, while often rich in pedagogical and content knowledge, face challenges integrating technology, which may stem from limited exposure during their early careers. These findings align with (Kabakci Yurdakul & Coklar, 2014), who argue that professional development tailored to specific age groups is essential to bridge this gap. Schools must implement mentoring systems where tech-savvy younger teachers support their senior colleagues in technology adoption. Furthermore, institutional support also plays a pivotal role in fostering TPACK development. Consistent with the findings of (Chai et al., 2013), this study underscores the importance of providing adequate technological resources, reliable infrastructure, and leadership encouragement. Teachers with access to well-maintained tools and an enabling environment are better positioned to experiment with and integrate technology effectively. This finding supports the socio-constructivist perspective that institutional culture significantly shapes teachers' attitudes and competencies in adopting innovative practices (VYGOTSKY, 1980)

Participation in technology workshops and teachers' personal attitudes further reinforce TPACK development. Workshops provide structured opportunities for teachers to acquire hands-

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on skills and apply them to real-world teaching scenarios, a point also observed in (Koh et al., 2018). Teachers' positive attitudes toward technology reflect their willingness to learn and adapt, as described by Rogers' Diffusion of Innovations theory, which highlights the importance of attitude in adopting new technologies (Sahin, 2006). Teachers with growth mindsets are more likely to view technology as an enabler rather than a barrier, fostering creativity in their instructional practices. This highlights the need for sustained professional development programs to nurture both skills and attitudes.

Conclusion

This study investigated the Technological Pedagogical Content Knowledge (TPACK) levels of Islamic education teachers in primary schools, focusing on their strengths and areas for improvement. The findings revealed that while teachers demonstrated strong Content Knowledge (CK) and Pedagogical Knowledge (PK), their Technological Knowledge (TK) and integrated domains such as Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPCK) were comparatively weaker. Influential factors such as age, teaching experience, participation in professional development programs, institutional support, and personal motivation were identified as critical in shaping teachers' TPACK levels. These findings highlight the challenges Islamic education teachers face in integrating technology into their pedagogy and underscore the need for targeted interventions to address these gaps.

To improve teachers' TPACK levels, educational institutions must prioritize structured and context-specific professional development programs. Workshops and training sessions should focus on practical strategies for integrating technology into Islamic education, ensuring alignment with teachers' pedagogical goals and subject matter. Institutional support, including access to modern technological resources and sustained mentorship, is essential for fostering confidence and competency in using technology. Additionally, fostering a culture of collaboration among teachers can enable knowledge-sharing and collective problem-solving, as suggested by the socio-cultural learning framework. Future policies should emphasize the importance of technological competencies in teacher certification processes and curriculum design to prepare educators for the demands of 21st-century learning environments. By addressing these areas, schools and policymakers can enhance the quality of Islamic education, making it more engaging, relevant, and effective for modern learners.

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